

## **Carbon-based Sorbent Systems for an Effective Containment of Hydrogen (New FY 2004 Project)**

*Dr. Guido P. Pez*

*Air Products and Chemicals, Inc.*

*7201 Hamilton Boulevard*

*Allentown, PA 18195-1501*

*Phone: (610) 481-4271; Fax: (610) 481-7719; E-mail: pezgp@apci.com*

*DOE Technology Development Manager: Sunita Satyapal*

*Phone: (202) 586-2336; Fax: (202) 586-9811; E-mail: Sunita.Satyapal@ee.doe.gov*

### **Objectives**

- Develop a new hydrogen storage technology using novel reversible H<sub>2</sub>-sorbent materials
- Deliver a packaged hydrogen storage system which will hold 6.0 wt.% hydrogen

### **Technical Barriers**

This project addresses the following technical barriers from the Hydrogen Storage section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

- B. Weight and Volume
- M. Hydrogen Capacity and Reversibility

---

### **Approach**

Air Products will develop a hydrogen storage technology using reversible H<sub>2</sub>-sorbent materials that will be contained in suitable robust, lightweight, low-cost containers. We propose to design and develop materials and processes for sorption-based hydrogen storage systems in support of DOE's FreedomCAR program and other portable-power initiatives.

Our goal is to devise hydrogen-containment systems of 6 wt.% H<sub>2</sub>-deliverable capacity at volumetric densities that range from 0.45 to 0.81 kg H<sub>2</sub>/L, that are operable with fast filling rates (<5 min.) within a specified (-40 to 90°C) operating temperature range and that achieve total reversibility over 500 cycles. The system's cost is limited to \$10/kg, which corresponds to \$833 for a fuel tank that carries 5 kg of usable hydrogen.

Our systems are to consist of a pressure/temperature H<sub>2</sub>-reversible solid sorbent material that is packaged in a lightweight container under a

modest pressure of hydrogen. The critical performance parameters are gravimetric and volumetric deliverable hydrogen capacity at specific loading and delivery process conditions. The sorbent's hydrogen capacity must actually exceed 6.5 wt.% in order to realize the ultimate goal of a hydrogen storage system which contains 6 wt.% H<sub>2</sub>.

Goals include designing reversible H<sub>2</sub>-sorbent materials: solid-state compositions that can take up hydrogen and release it by only varying the system's externally variable parameters of temperature and H<sub>2</sub> pressure, without the introduction or release of any other substances. Our ultimate goal of Phase I is to deliver to DOE a small prototype (0.1-1 kg sorbent) of a packaged hydrogen storage system that operates by temperature- or pressure-swing adsorption and utilizes a hydrogen sorbent material that has a reversible capacity, by total package weight, of 6.0% hydrogen in the specified temperature range (-40 to 90°C) and under moderate pressure of hydrogen (<1000 psia).

If successful in Phase I, we intend to submit to DOE a proposal for research and development towards an adsorbent production process (at a target cost of <\$5/kg) and continuation of the packaged system prototype development, including integration of the packaged system with a commercial fuel cell stack.